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CONTENTS

ECONOMIC

TRADING COMPANIES' ROLE IN ADVANCED TECHNOLOGY DISCUSSED

Tokyo SENTAKU in Japanese Sep 82 pp 76-78

[Article: "General Trading Companies Cannot Catch Up With Advanced Technology"]

[Text] "The trade handled by the trading companies today includes iron and steel, chemicals and energy," (a large general trading company former employee).

It has been several years since the decline of trading companies was first noticed. The pace of the depression which is overtaking the general trading companies is steadily quickening.

The 1981 settlement of accounts indicated that seven out of nine big trading companies, except for Mitsubishi and Sumitomo, were almost in the red. The profits made over the period were completely eaten up by irrecoverable redemption funds, including bad debt and bad investment. They are barely tiding over the settlement of accounts by selling stock in the property.

For several years, the general trading companies have been searching for future items. One of the biggest targets is the advanced technology industry.

But how much room is left in the advanced technology field for the general trading companies to occupy?

Booming "Technology Offices"

Since last year, self-important new organizations with names such as new field development team and technology office have been born one after another in every trading company.

For example, C. Itoh & Co's new field development team in its business department was started in October last year, Sumitomo Shoji's bioengineering project team in February this year, Mitsubishi Shoji's technology office and Marubeni's new technology office in April, and Kanematsu-Gosho's chemical product headquarters and chemical product enterprise development office in May.

These moves were all aimed at trade in the field of biotechnology, which is one of the advanced technologies today. As far as organization aimed at advanced technology is concerned, Mitsui Bussan established a technology department in August 1970, and Nissho-Iwai a technology office in February 1974. These two companeis are the "old shop" among the general trading companies.

However, it is a different story as far as today's hottest technology is concerned, even for Mitsui Bussan and Nissho-Iwai, which are considered to be in the vanguard. It is highly questionable how much these two "old shop" enterprises have achieved in the fields of semiconductors, electronics, CAD (computer-aided design), CAE (computer-aided engineering) which is more advanced than CAD due to its use of computer technology over the entire range of the production development process, biotechnology, gene manipulation, computer graphics, artificial intelligence, solid electrolyte, and CADD.

For those trading companies which do not engage in their own technology development, "advanced technology" means to catch other companies' advanced technology information as soon as possible and then act as intermediaries between the makers and the consumers, and to catch the information needed to expand the volume of products produced by the new technology which is handled by its own company.

This is not going very well, no matter which trading company one looks at.

Mitsubishi Shoji and Bussan are two general trading companies which are representative of Japan. For the past several years, these two companies have been suffering hardships. Mitsubishi Bussan went into the red finally in the 1981 settlement of accounts due mainly to the IJPC problem, while Mitsubishi Shoji relies on liquefied natural gas (LNG) for the greater part of its profits.

Although Mitsubishi Bussan led other companies in establishing a "technology department" 12 years ago, its original motive was to gather from abroad the newest information concerning the petrochemical industry. To be sure, the technology department of Mitsubishi Bussan has done brilliantly in this area. The advanced petrochemical technology introduced by its technology department was later brought to fruition by makers including Mitsui Petrochemical, and technical personnel from various departments, including the mechanical, food, and paper pulp departments, were poured into the technology department.

Today this is nothing more than the advanced technology information of an era ago. How much achievement is made by the technology department in fields which are considered to have potential in the future?

Mitsubishi Bussan was the envy not only of the other trading companies but also of the medical supplies makers as well as food-related industries when its technology department succeeded last year in linking up with the U.S. Genentech, which was sought after as the favorite among biotechnology pioneers. Because biotechnology is the technology which can make

industrial-scale mass production of methanol (industrial alcohol) as an energy source, pomato (a hybrid between potato and tomato) as an effective weapon to combat the food shortage, and medical supplies such as interferon a reality.

President Swanson of Genentech was invited by the technology department to visit Japan, and the company's technological appeal was displayed for him. Mitsubishi Bussan had also contacted other comapnies similar to Genentech and boasted: "We are intermediary to nearly half the industry through cooperation between them and Japanese enterprises." However, it does not have much to show as far as CAD, CAM, and electronics are concerned.

Mitsubishi Shoji, too, is not very sensitive to the advanced technology. Dainippon Machinery Industry, which has headquarters in Yamanashi Prefecture, is Japan's only special maker of robots, and the European market has been exploited over the past several years. That was the last resort, because domestic medium and small enterprises were not buying any robots. Mitsubishi Shoji is said to have acted as the intermediary when this European advanced was made. A more accurate description of the truth is that Mitsubishi Shoji merely followed Dainippon Machinery Industry. Mitsubishi Metal's "silicon single crystal," which is a raw material used in semiconductor manufacturing, is handled only slightly by a small number of personnel in this company. The handling of products in the electronics field is the area most lagging among all the areas handled by the company.

Subsidiaries Hustle Better Than the Parent

Compared with Mitsubishi Shoji and Bussan, other companies led by C. Itoh & Co have challenged the advanced technology field more aggressively.

CAD, in particular, has been pursued by Marubeni and Sumitomo since the mid-1970's. CAD is a technology which increases the efficiency of design process through the use of graphics process technology. This technology was developed mainly by the U.S. auto makers and aircraft industry, including GM. In Japan, CAD was introduced by Toyota and Nissan in earnest only recently, and an independent market is being developed.

Marubeni had its eyes on CAD from early on. Marubeni approached Mr Haranty [phonetic], who engaged in the development of CAD at GM and later left GM to organize the independent MCS Co, even before he became an independent. Nevertheless, it failed to see that CAD was a "golden egg" which would grow into a domestic market of 40 billion yen a year today (120 billion yen by 1985). The person who was in charge at that time was mortified: " If only we had gone into it further at that time."

There was a similar case concerning the domestic agent rights to handle CAD. The venture business famous in the field of CAE is the SDRC Company of the United States. A certain trade company which noted the existence of SDRC Company and kept contact with it decided several years ago that the time was not ripe and gave up altogether the introduction of the technology to Japan. However, the SDRC Company, in cooperation with GE, landed in Japan this year. This is an example of discovering a golden egg yet losing the timing to hatch it.

Be that as it may, others are more persistent in their efforts than either Mitsubishi Shoji or Mitsubishi Bussan. In the field of advanced technology, especially computers and electronics, C. Itoh & Co, Marubeni, Sumitomo Shoji, and Kanematsu-Gosho have adopted a 100 percent subsidiary strategy and thus achieved considerable results. Typical examples include the importation of semiconductor manufacturing equipment from the United States over the period from the mid-1960's to the early 1970's.

Without this semiconductor manufacturing equipment Japan could not have achieved the prosperity of its semiconductor industry today. Importing this technology and introducing it to Japan was truly an important achievement. In addition, there are also some other individual cases. For example, C. Itoh & Co's data system software "Karma" for CAD, Marubeni Hitec's "Applicon," and Nissho Electronic's software "SAS" for computer graphics are holding up well.

Though struggling with a settlement of accounts in the red, Kanematsu-Gosho has established seven or eight subsidiary companies dealing with advanced technology. Of these subsidiary companies, Kanematsu Electronics has grown so much as to be listed next year.

Kanematsu Electronics may be an exception. The truth of the matter is that these subsidiary companies must compete with some 200 medium and small companies specializing in computer and electronics.

One of the important technologies related to CAE is solid modeling. This is a technology for creating a picture image which looks exactly like the real thing using a computer. It is a system indispensable for the development of complicated machines. The Shape Data Co of Great Britain is especially highly valued in the field of solid modeling. A special trading company of the Sumitomo group and Rikei, a trading company specializing in electronics, competed for Shape Data agent rights in Japan, and Rikei was the winner.

In the field of computers, artificial intelligence has not yet been claimed by any trading company. In this field, the user is leading the trading company. Computer makers and large enterprises are dispatching personnel to the United States to acquire the technology. The trading companies may have no role to play unless something is done. Even in the field of biotechnology, not to mention the example of Mitsui Bussan, the trading companies are doing no more than matching Japanese enterprises with European and American venture businesses for research contracts--very nearsighted behavior.

Like Buying a "Lottery Ticket"

Why are such matters not going well? A number of reasons come to mind. First of all, there is the nature of the trading company. The trading companies during their high rate of growth period continued to expand mainly through commissioned trading with the major industrial makers. Therefore, the commodities handled by them consisted mainly of raw materials. This structure has not been changed basically up to today. They depend entirely on energy and the raw materials industry, so their organization and personnel are also

firmly bound up with this structure and there is no room for advanced technology to enter at present.

The second reason is the fact that the makers themselves are engaged not only in production but also in acquiring technology. The advanced technology information provided by the trading companies' network can no longer satisfy the needs of the makers.

Before the war and for a dozen of years afterward, the technical information provided by the trading companies represented by the technology department of Mitsui Bussan was still highly effective. Since then, the only notable achievements made by the trading companies has been the importation of semiconductor manufacturing equipment carried out mainly by subsidiary companies. Today, the larger the maker is, the less likely will it be to lend its ear to the trading company's information.

The third reason is the consciousness of the leaders of the trading companies. Establishment of a technology department or an office is fine in itself, but it is not quite clear how far the leaders of the trading companies, who are oriented toward expanding the handling volume, will positively cultivate trade related to advanced technology, which involves a minute handling volume. The leaders of the nine major trading companies are operators of a volume-oriented era. Although they may be able to understand mentally that a terrible era will be upon them unless a shift to the advanced technology field is made, they have difficulty translating this into action. They may be a type of "man of the past."

Ten years ago, 20 million yen a year were said to be required to maintain the technology department of Mitsui Bussan. A department or office requires funds to maintain it once it is established, and no one can tell when an achievement will be made. Therefore, nothing is more wasteful than to keep on maintaining an organization in accordance with the mood of the world called "advanced technology." A person who played a central role in establishing a technology department for a large trading company observed the trading company's excitement of late and commented: "It is just like buying a partimutuel ticket or a lottery ticket." A matter which cannot be simply laughed off.

9113
CSO: 4105/207

SPACE DEVELOPMENT DRAFT BUDGET TOTAL 87,600 MILLION YEN

Tokyo JPE AVIATION REPORT-WEEKLY in English 15 Sep 82 pp 9-10

[Text] The Science & Technology Agency requests ¥87,600 million in FY 1983 disbursement and ¥55,755 million in appropriation in subsequent years for space development programs, including the start of development work for the No. 3 broadcasting and No. 5 engineering test and other satellites. The requested funds are almost the same as approved in FY 1982.

Satellite-related funds out of the budget request total ¥35,958 million, including ¥4,900 million for development of the No. 3 geostationary meteorological satellite for launching in FY 1984, ¥12,000 million for developing the No. 1 maritime observation satellite for launching in FY 1986, ¥960 million for starting development of the No. 1 earth resources satellite ¥10,840 million for launching the No. 2 b communications satellite and the No. 2 a broadcasting satellite in FY 1983, ¥680 million for starting development of the No. 3 a and b communications satellites for launching in FY 1987 and 1988, ¥20 million for starting development of the No. 3 broadcasting satellite, ¥768 million for starting development of the engineering test satellite V for research on geostationary three-axial control satellites and mobile communication tests, ¥120 million for considering participation in U.S. space station programs, and ¥1,210 million for developing the first space material testing system.

Funds for development of satellite-launching rockets aggregate ¥34,223 million. The agency plans to continue in FY 1983 development of the N-II and H-1 rockets. The H-1 is designed to launch a 550-kilogram geostationary satellite. A two-stage H-1 would be test fired in FY 1985 and a three-stage model in FY 1987. The agency would also try to improve the thrust of the H-1.

Funds earmarked for the National Aerospace Laboratory's space development study total ¥838 million, including ¥91 million for research into a rocket fueled by liquid oxygen and hydrogen, and ¥6+ million for study of basic satellite technology.

CSO: 4300/001

ELECTROGYROCATOR IN AUTOMOBILE INTERNAL NAVIGATION SYSTEM

Tokyo JIDOSHA GIJUTSU in Japanese May 82 pp 528-534

[Article by Katsutoshi Tagami, Tsuneo Takahashi, and Fumitaka Takahashi: "Internal Navigation System for Use in Automobiles 'Electrogyrocator'"]

[Text] 1. Introduction

The spectacular advancements in automobile technology together with the accompanying rapid development of the highway environment in the past have resulted in rapid advances in motorization, and the automobile has proven to be a transportation medium providing a "faster and more comfortable means for going anywhere one wishes" that offers a high degree of freedom motor capability, optionality, extreme rapidity, and convenience, and it will continue to play an important role in our lives even from here on.

On the other hand, the recent large increase in automobile traffic and expansion of the motoring sphere have been accompanied by a situation in which the highways and the traffic situation make it difficult to exploit fully the convenience that can be provided by the automobile. When compared to the railway as a means for overland transportation, the automobile provides the driver a means of locomotion which has much greater degree of freedom. On the other hand, the so-called "navigation method" for searching for a good route to follow is completely dependent on the experience of the driver, intuition, or highway signs and markers. There are often cases of losing one's way and needless waste of fuel as a result of taking one of the side roads intermingled with the concentration of main highways, taxing the driver's physical and mental capabilities, losing a lot of time and resulting in great energy loss in a situation that has persisted from the past.

Only now are the ships which ply the seas beginning to switch from their former dependence on the sun and the stars as navigational aids to a new navigational method based on electronics, while jumbo jets equipped with "inertial navigational equipment," an application of the gyro and electronics, are daily crossing the Pacific and arriving at their targeted destinations. On land, man has progressed from "walking" to "riding," and he arrives at his destination through the use of signs and guideposts; however, the information collection technology for determining one's location when in an automobile is still at a stage that resembles primitive man's use of broken tree branches or piles of stones to mark the way.

In an effort to enable the automobile to continue to develop from here on as a convenient means of transportation in our daily lives, research is underway in various countries to improve the efficiency and rationality of use of automobiles from the combination of man, automobile, and environmental system; the use of various types of information relating to automobiles and of inductive systems is an example. On the other hand, many of these systems require fairly large equipment or facilities as well as social consensus, and they will require considerable time before they become practical. With this background, the "inertial navigation system for automobile use" was developed as one approach to respond positively to users' needs and provide the possibility of expanded functions for use by automobiles.

2. Aim of the Development

A navigational means which does not depend on passive reception of information from an external source such as a radio station but allows operation over a known course and also allows a choice of course with changes in the situation according to highway and traffic conditions through the installation of an auxiliary device on motor vehicles is the "inertial navigation device" which is found on some buses. If such a device were installed on an automobile, back roads could be avoided and the optimum or shortest route to the destination could be selected, thereby naturally preventing energy loss and improving the overall motor efficiency. Furthermore, a person woefully lacking in knowledge of geography could safely drive over unfamiliar roads or at night, and the functions of the automobile could be greatly expanded beyond those of the past.

This device does not depend on external facilities or unstable phenomena such as the earth's magnetism. As a result of the technological pursuit of the practical use of a completely self-navigational method for automobiles, the following are at hand:

--Practical sensing technology for sensing changes in the automobile's direction through the use of a high-precision and high-performance gas rate gyro and sensor performance correction through computers

--A man-machine closed loop system structure with route track display of high information display capability on the route being taken and transmission color map display

--Joint use of a self-compilable special-use map and erasable special pen with high degree of utilization.

These are the foundation of the judgment aid for course selection to adapt to changing situations; the facility will show where the trip started, the present location, and the direction to take toward the destination; this is a facility that has been assembled to enable ready utilization anywhere, anytime and anybody.

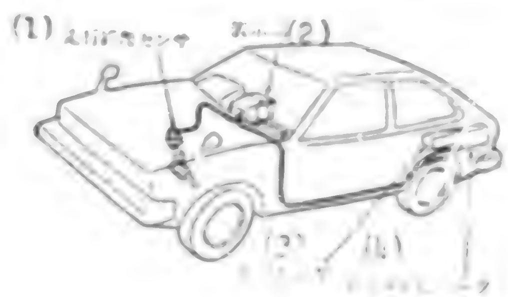
3. Facility Makeup and Principal Specifications

This facility detects the "direction" and "distance" an automobile travels through a precise gas rate gyro sensor and distance sensor; the many changes

which occur during the operation are instantaneously integrated by computer and continuously recorded and computed so that the total movements of the vehicle can be extracted and displayed on a Braun tube upon which a transparent route map is imposed which shows accurately the route to be traveled. That is to say, the course of the vehicle and the road to be traveled are clearly displayed on this map.

Functionally, this unit has the same functions as the inertial navigation device on large passenger aircraft (for example, the Boeing 747), which does not use the earth's magnetism or a radio, as a result of which the effects of these external disturbances are not received; the immediate position is determined by one's own capabilities in this inertial navigation device for automobile use. The inertial navigation device used for aircraft detects the acceleration in three orthogonally intersecting directions, and the information is integrated twice to calculate the position on a three-dimensional position coordinate scale, after which the results are converted to the inertial coordinate system to display the immediate position. In the case of an automobile, the distance traveled is readily calculated from the rotation of the tires and travel is limited to roadways, so all that is necessary is to determine the distance from a planar road map or, what is equivalent, a two-dimensional coordinate system.

The use of this facility in an automobile is shown in Figure 1, the display state with map in place is shown in Figure 2, and the basic makeup of the facility is illustrated in Figure 3.



Key:
1. Trip distance sensor
2. Display section
3. Director sensor
4. Navigational computer

Figure 1. Use of Facility

Figure 2. Display State With Map Sheet Inserted

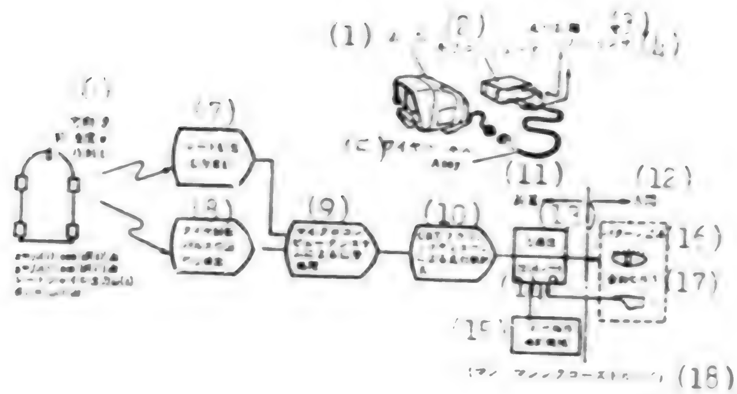


Figure 3. Basic Makeup Diagram of Facility

Key:

1. Display section
2. Navigational computer
3. Trip distance sensor
4. Direction sensor
5. Wire harness assembly
6. Direction θ, speed v, time t
7. Rate detection signal conversion
8. Tire rotation pulse detection, stop detection
9. Signal treatment by microcomputer
10. Key route display by CRT graphic
11. Facility
12. Man
13. Transparency
14. Map sheet
15. Combined driving aid machine
16. Pattern recognition
17. Combined operation
18. Man-machine closed loop

One of the features of the basic makeup of this facility is the combination of the trip route display and the transparent color map which comprises the man-machine closed loop system. When the present location obtained from the results of the navigational calculations is displayed as a point information display and there is an accumulation of errors in coordinates due to errors in direction detection, distance detection, initial position, or map precision, a different position may be indicated on the map with its complex and intimately linked road network, the operator may be confused in trying to decide whether the system is in error or whether the automobile is actually at the location indicated. When a trip taken in the past between precisely fixed points is displayed continuously on the same map at the same time, it is possible to compare the trip route and the road system even though the present position is not on the trip route so that it will be possible to determine readily which route one's own car is on as well as to display the long-term integrational error from the starting point utilizing a feature unique to the inertial navigational principle.

The principle specifications of this facility are listed in Table 1.

Table 1. Principal Specifications of Facility

Display	P 31 fluorescent 6-inch CRT Effective size of display 80 mm x 100 mm Length of trip route display 80 mm MAX Variable scale range $\frac{1}{7,000} - \frac{1}{400,000}$
Computer	16-bit microprocessor (8-bit external bus) ROM 10 KB SRAM 1 KB DRAM 16 KB
Trip distance sensor	8-pole magnetic rotating hole IC pickup
Direction sensor	Gas rate gyro sensor (helium gas) Detection range -70°C/sec - +70°C/sec Output sensitivity 5V/100°C
Map	0.1 t lumilar film transparent multiprint offset printing sheet Sheet size A 5 Basic scale $\frac{1}{250,000}$
Electrical power supply	DC 12-V automobile battery Current consumption average 3.5 A (preheating time 12 A MAX)
Weight	About 9 kg
Operating temperature range	Display section -30°C - +80°C Computer -30°C - +60°C Trip distance sensor -30°C - +120°C Direction sensor -30°C - +60°C

4. Principal Constituent Parts and Features of the Construction

4.1 Trip Distance Sensor

The trip distance sensor uses a pulse detection method to generate electrical signals in response to the rotation of the tires and instructs the computer on the distance traveled by the car. At the same time, this pulse detection also serves to detect the car when it is stopped as well as the distance traveled.

The sensor counts the tire rotations through the number of rotations of the speedometer cable by temporarily disengaging the speedometer cable from the takeout hole in the transmission section and inserting and connecting a hole element type rotation detection unit.

In order to enhance reliability and detection resolution, a noncontact type detection using a hole element was adopted, and eight pulses are generated per cable rotation.

The external appearance of the trip distance sensor is shown in Figure 4.

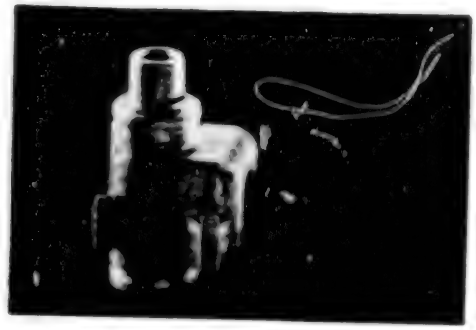


Figure 4. External Construction of Trip Distance Sensor

4.2 Direction Sensor

The direction sensor is a precision gyro, with helium gas sealed in and no moving parts, which responds very accurately to changes in direction of the vehicle and generates electrical signals to instruct the computer in the direction of travel.

This is a self-reliant navigational system which does not depend on external installations or the earth's magnetism--which are sources of unstable information--but calculates its current position through its own capabilities; the introduction of a yaw rate gyro of high performance and high precision was tested as a direction information sensor. As the result of these studies, a gas rate gyro was selected as the gyro best suited at the present time as practical for use as an automobile part.

This gyro is comprised of a main section in which are enclosed a helium gas circulating pump, injection nozzle, and flow sensor in a single package, along with a constant temperature chamber section to maintain the above members at constant temperature and a control circuit section, all of which are put together in a compact package. An external view of this gas rate gyro is shown in Figure 5.

Figure 5. External Construction of Gas Rate Gyro

As illustrated in Figure 6, the makeup of this gas rate gyro includes a spin vibrator type pump to circulate helium gas, an injection nozzle to generate uniform helium gas flow, and two heated wires to detect any aberration in this flow. A block diagram showing the different functions of the gas rate gyro is shown in Figure 7. When the vehicle is proceeding directly forward helium gas reaches these two wires equally so that the temperatures of the two wires remain the same, but when the vehicle changes direction there is imbalance in the flow of helium gas and a temperature differential is created between the two wires. This temperature differential is detected as an electrical output, and the change in direction of the vehicle is sensed.

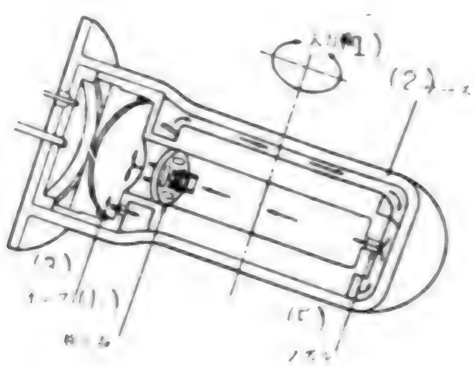


Figure 6. Construction of Gas Rate Gyro

Key:
1. Input axis
2. Case
3. Pump
4. Detector
5. Nozzle

As is evident from the basic principle discussed above, it is important just how the temperature balance between the two heated wires is maintained when the car is maintaining a straight forward course in order to realize high precision and high performance. If there is an imbalance in this temperature, there will be a temperature differential even when the car is on a straight course, and a signal will be generated each time the vehicle changes direction. At the same time, a construction which facilitates finishing operations and mass production is important along with the transfer of this high precision and high performance to operations in the automobile environment.

Systematic pursuit of limits and tradeoffs were made until these various factors could be incorporated in the details for the various sections, such as a double constant temperature tank construction, sensor section, and circuit section, and thereby establish a practical technology for a rate gyro for use in automobiles while, at the same time, this product represented spectacular improvement along the lines of its specifications.

The sensitivity characteristics are shown in Figure 8, and the stability with time property of the no input-output voltage is shown in Figure 9.

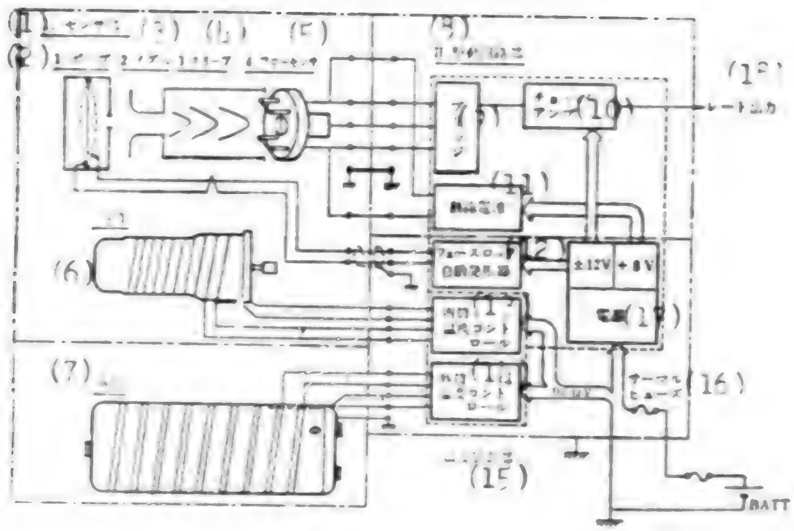


Figure 7. Block Diagram of a Gas Rate Gyro Showing Different Functions

Key:

1.	Sensor section	10.	Chopper amp
2.	Pump	11.	Power supply for heated wires
3.	Nozzle	12.	Phase lock self-excited oscillator
4.	Sleeve	13.	Inner tube temperature control
5.	Flow sensor	14.	Outer tube temperature control
6.	Inner tube	15.	Temperature control section
7.	Outer tube	16.	Thermal fuse
8.	Drive circuit section	17.	Power supply
9.	Bridge	18.	Rate output

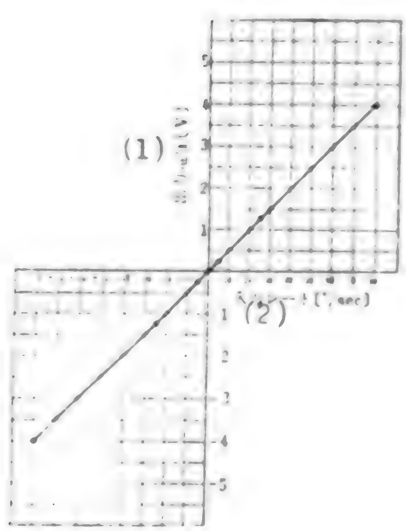


Figure 8. Sensitivity Characteristic of Gas Rate Gyro

Key: 1. Output voltage (V) 2. Input rate (°/sec)

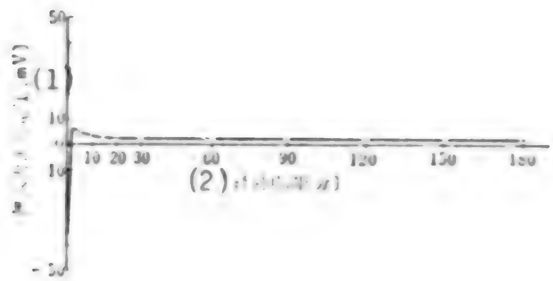


Figure 9. No Input-Output Voltage Stability of Gas Rate Gyro

Key: 1. No input-output voltage (mV) 2. Elapsed time (min)

4.3 Navigational Computer

The computer successively calculates the present position from the electrical signals on direction and trip distance and makes a display of the trip course derived from these signals by reference to the stored two-dimensional coordinate data table. Unlike the general-use computer of the past, this computer takes in much more precise electrical signals, while the navigational computer treatment includes many integration operations and repeat calculation elements, so that a high degree of accuracy is required to keep cumulative errors in the calculations from becoming a problem. At the same time, together with this highly accurate treatment, there is need for high-speed treatment so that the latest data can always be at hand relative to the successive movements of the automobile.

A computer to be used in an automobile should incorporate cost, reliability, and shape features which are in the range of practicality with high-precision and high-speed hardware and software; the initial type tested was an 8-bit external bus type 16-bit microprocessor and multitask monitor type software.

An external view from the printed base plate installation side of a computer unit is shown in Figure 10. This unit is constructed so that the computer printed baseplate and the power supply printed baseplate are each detachable from both sides of the cover. The computer printed baseplate is where the 16-bit microprocessor is tied in with ROM, SRAM, and DRAM as well as an 8-bit external bus, and the peripheral circuitry is mostly made up of two sole-use IC's to miniaturize the unit. The A/D conversion circuit section is molded into the metal case and is in the form of a sole-use module to enable high-precision stability even in the environment of a car.

The makeup of the computer system is illustrated in Figure 11 in the form of a block diagram. The following constitute the principal contents.

Figure 10. External View of a Navigational Computer

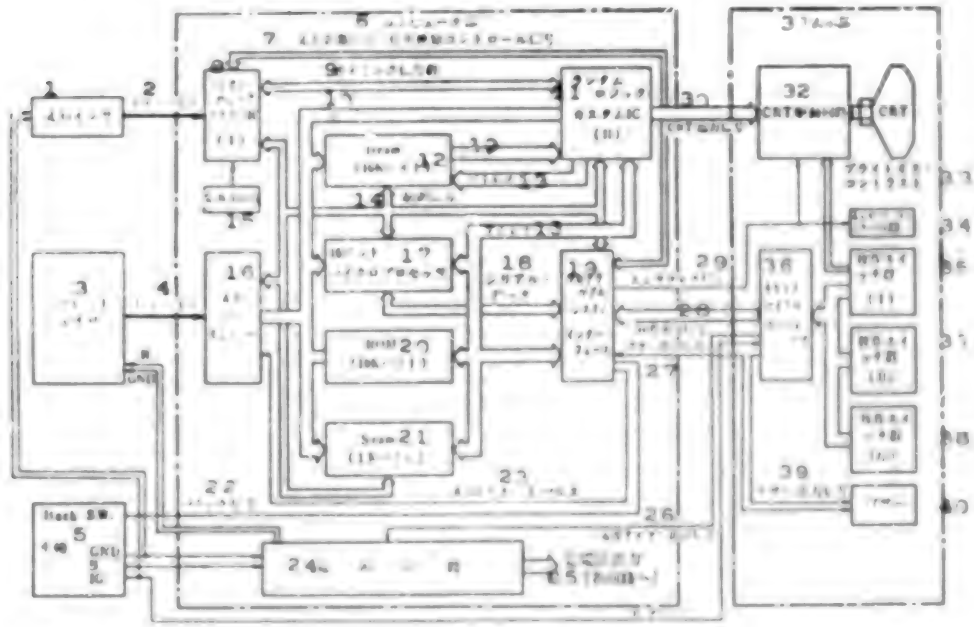


Figure 11. System Block Diagram

Key:

1. Trip sensor
2. Vehicle speed pulse signal
3. Gas rate gyro
4. Yaw rate signal
5. Wheel
6. Computer section
7. Trip distance signal, stop detection control signal
8. Random logic custom IC
9. Timing signal group
10. Data
11. Random logic custom IC
12. DRAM (16 kilobytes)
13. Address
14. Control signal
15. Oscillation circuit
16. A/D converter module
17. 16-bit microprocessor
18. Serial data
19. Programmable system interface
20. ROM (10-kilobyte)
21. SRAM
22. Back signal
23. A/D start pulse
24. Power supply circuit
25. Constant voltage output (to each circuit)
26. Power supply timer output signal
27. Buzzer output signal
28. Operating input signal
29. Display suppress signal
30. CRT output signal
31. Display section
32. CRT drive circuit
33. Brightness contrast
34. Display mode indicate LED
35. Operating switch group (I)
36. 4-bit microprocessor
37. Operating switch group (II)
38. Operating switch group (III)
39. Buzzer output signal
40. Buzzer

1) Successive direction of travel angles are calculated for the automobile from the unit distance traveled signal from the trip distance sensor and the yaw rate signal from the direction sensor, and the present position on a two-dimensional coordinate is calculated successively to construct a data table of trip distance coordinates for a fixed distance.

2) The coordinate array recorded on the data table can be expanded, reduced or rotated in the graphic treatment of the route traveled.

3) Reception and treatment of operating command signals.

4) Automatic correction of zero point drift of the direction sensor at the time the automobile stops.

5) Self-diagnostic treatment of the system and message display.

4.4 Display section

The display section picks up signals from the computer to display the trip trace, present position, and the direction headed by the automobile on a 6-inch Braun tube.

The factors which must be taken into account before placing a CRT (cathode ray tube) display device in an automobile are the following:

1) It must be large and its field of vision must not be obstructed. This layout involves maximum suppression of overall height of the display, and taking the display area of a practical nature into account, a 6-inch Braun tube placed sideways was adopted.

2) The brightness of the display must not be inferior to the surrounding brightness. The brightness of the Braun tube was increased, and hood and expanded lens type installations were made to minimize direct solar rays in order to bring the brightness to a practical level. At the same time, a neck turning mechanism was installed so that the viewer can obtain an optimum field of vision and operation.

3) There must be no hazardous situation even when the automobile is involved in an accident. The front of the display section is padded with an external structure using soft cushioning material, and the operating switches and levers are of a collision free form. Even if the Braun tube should be shattered through a possible accident, a protective acrylic plate placed over the front surface will prevent broken pieces from being scattered. In addition, the construction provides considerable shock-absorbing capacity.

The various operating systems of this facility are shown in Figure 12. The entire assembly is deployed at the periphery of the display section. An external view of the structure is shown in Figure 13.

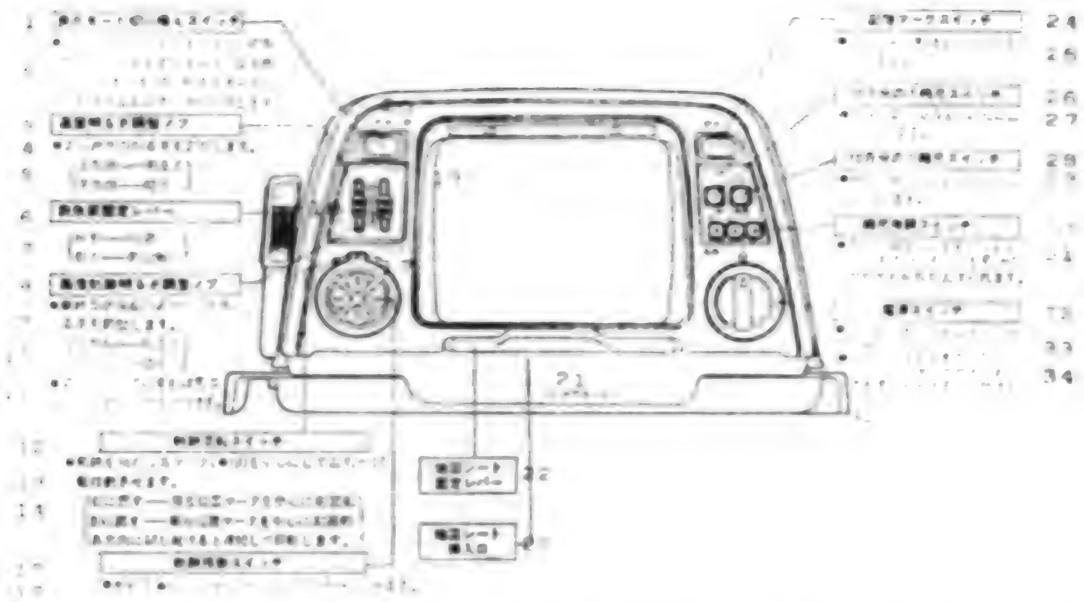


Figure 12. Names and Functions of the Different Operating Systems

Key
1. Display mode switch
2. This switch enables change from normal operating mode to the display mode for use when the vehicle is stopped. (The display lamp goes out in the stopped mode.)
3. Picture brightness knob
4. Adjust picture brightness
5. Up: brighter, down: dimmer
6. Display section fixing lever
7. Press: fixed, pull: released
8. Knob to adjust brightness of track on picture
9. Adjusts brightness of track and present position
10. Up: brighter, down: dimmer
11. Lowest position eliminates the picture without cutting off the power supply
12. Track rotation switch
13. The track can be rotated left-right with the mark of the present site (• mark) as center
14. Rotate right: rotation to right with present site mark as center
    Rotate left: rotation to left with present site mark as center
    If knob continues to be turned, the picture will continue to rotate
15. Track translation switch
16. Makes left-right, up-down parallel translation of track in the direction of the Δ symbol
17. Direction setting
18. Display cutoff
19. Picture brightness
20. Display mode
21. Map insertion slot

[key continues]

[Key to Figure 12 continued]

22. Map sheet fixing lever
23. Map sheet insertion slot
24. Function mark switch
25. Press this and leave a · mark on the picture
26. 1: 250,000 reduction switch
27. Reduces scale to 1: 250,000
28. 1: 100,000 reduction switch
29. Reduces scale to 1: 100,000
30. Fine adjustment of scale switch
31. Starting from the left, the scale is raised by 1/100,000, 1/10,000 and 1/1,000
32. Power supply switch
33. Turn 90° to right to put power supply on
34. There is a "Please wait a few minutes" display until preheating is complete; preheating is completed in 5 minutes to bring the system to operating state

Figure 13. External Construction of Display Section

There is also a switch which is used rather infrequently but nevertheless has an important function which is placed on the display section side, and it is provided with a cover to prevent inadvertent touching. There are, in addition, a timer switch which allows the functions of each switch to be continued a maximum of 90 minutes after the IG switch has been cut off, a distance correction switch for use when the tire size is changed, a sensitivity adjustment switch for the direction sensor, and a track erasing switch--all of which are provided to facilitate maintenance.

An external view of the switch deployment on the display section side is shown in Figure 14.

Figure 14. Switch Deployment on Side of Display Section

4.5 Special-Use Map Sheet and Pen

The special-use map is divided into blocks, and assembly of all the blocks will cover the whole country. This map is created by offset printing using multicolor ink on transparent polyester film; it is colored taking into account its adaptability to the automobile cabin environment and ready readability, while overlaps are provided at the edges to enable easy switchover to the next map block panel.

The degree of freedom in the utilization of these maps is enhanced by allowing the operator to select only the maps he needs, placing o marks on target sites, tracing the planned course with a special marking pen, and selecting only the necessary maps for use to be put away in a carrying case.

The marking pen is an erasable type whereby erasures can be made by the use of the eraser at the opposite end from the marking point, the eraser can be exposed by removing the cap.

Special-use maps and pen are shown in Figure 15.

Figure 15. Special-Use Maps and Pen

5. Examples of Application

5.1 Utilization Effect

This facility was used in actual operation evaluation tests, user monitor tests, and tests involving the complex road systems of congested urban centers, local roads removed from trunk highways, high-speed highways, and mountain roads, and some difficulties were encountered in the manner of handling these map sheets. The following are the principal items in the evaluation that was made.

There is great feeling of safety in unfamiliar territory where anxiety can be great. When unexpected tieups due to construction are encountered, a quick detour can be made following the behavior of the local drivers.

When on a long trip, the shortest course or the optimum course can be selected en route, thereby greatly easing driver fatigue and saving time and fuel.

When a wrong turn is taken, the error is detected immediately, enabling quick corrective measures.

At night in an area where no signs of markings are evident and there is no one familiar with the area, uneasiness is eased, and the facility plays the role of a guide.

5.2 Development of a Utilization Method

This facility is used not only as a means to indicate present position on a road map, but a very wide field of applications is anticipated. The following are some examples.

--The starting points and roads recorded on the Braun tube can be used as guides for reference independent of the road map.

--A tour around a certain installation will give one knowledge of the area and the shape of the district.

--Detailed knowledge can be obtained of road conditions in mountain and remote areas shaded by trees making aerial photographs inadequate.

--By copying the trip track with a special pen or camera, a record can be prepared for patrol use or business delivery route use.

In this manner, various needs can be fulfilled and new applications can be developed according to the user's ingenuity.

In addition, it is possible to use a transparent sheet on which has been placed relevant information from commercial road maps in place of the special maps, and the results will still be satisfactory.

5.3 Precision of Trip Track

The precision of the trip track display will vary considerably with the course traveled and the speed distribution during the trip, making simple quantitative definition difficult. The ultimate positional error is greatly controlled by just how the errors of the various constituent parts are woven into the errors generated by the course and speed distribution. This facility makes correction by computer for these errors by compiling the various factors with a common degree of influence on the precision in the trip track for use in the correction.

The precision is very high where the route is comparatively straight, travel is through a section of many traffic lights, or roads where left and right turns occur alternately in a repeated manner. On the other hand, travel over high-speed highways where there is no occasion for stopping and the drive continues uninterrupted for long hours or travel over mountainous roads with large turns and large map deformations results in low precision. This precision problem is fairly minimal from a practical viewpoint on these highways and mountain roads with very few branching roads.

Model examples of travel over general roadways are shown in Figures 16 and 17.

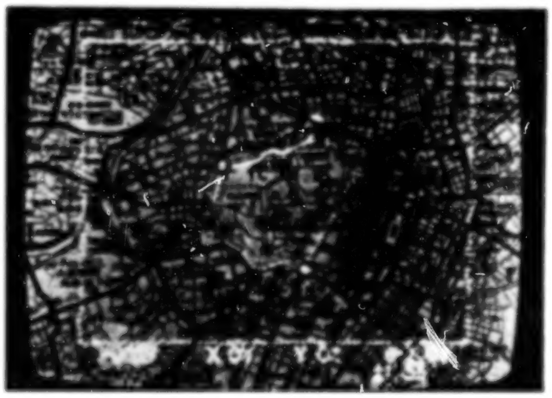


Figure 16. Example of Travel Over General-Use Roads (circuit trip

The Imperial Palace was circled following the moat, and return was made to the starting point

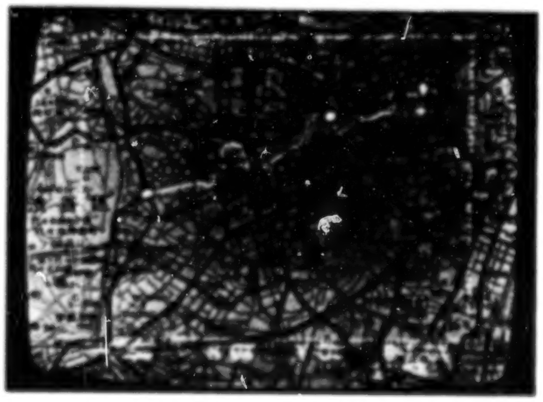


Figure 17. Example of Travel Over General-Use Roads (from departing point to destination)

Leaving home, the Diamond Hotel in Chiyoda-ku was the destination via Shingu

6. Concluding Statements

This facility was designed to test the practicality of an inertial navigation system for automobile use, and it is believed that regarding the function,

it has demonstrated to a certain degree the ability to respond to the user's needs and, at the same time, it has been shown to possess potential for a wide range of other technological applications. This "navigational" function is almost nonexistent in automobiles compared to aircraft and ships, and it is one of the necessary items for future utilization of automobiles which needs to be developed. We anticipate that this facility will be an aid to raising the curtain on the age of navigational automobiles.

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